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CALIFORNIA TEACHERS' QUARTERLY

Containing Third Installment of the Proceedings of the

Fortieth Annual Meeting of the

CALIFORNIA TEACHERS' ASSOCIATION

held at

FRESNO,

Dec. 26, 27, 28, 29, 1906.

September, 1907.

The CALIFORNIA TEACHERS' ASSOCIATION, Publishers.

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....The....

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Fresno, December 26, 27, 28, 29, 1906.

SEPT., 1907.

Published by the California Teachers' Association.

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...The...

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SEPTEMBER, 1907.

Announcement.

The Meeting at Santa Cruz.

THE people of Santa Cruz will give the teachers of California a most hospitable welcome at the meeting of the State Association next winter. They will open the Sea Beach Hotel for the entire week of December 30th.

Dr. James L. Hughes of Toronto, Canada, has been secured and other Eastern men are expected. Dr. David Starr Jordan has already accepted an invitation to address the teachers during the association, and President Benjamin Ide Wheeler also will give at least one address during the meeting.

Several County Superintendents have already called their institutes to meet at Santa Cruz during the association week.

Santa Cruz, Santa Clara, San Benito, San Joaquin, and Alameda counties are already making arrangements for the meeting.

More emphasis will be laid upon the social side than ever before.

On Tuesday, December 31, 1907, at 8 o'clock p. m. a concert will be given after which there will be a musical reception and watch meeting.

The Board of Trade of the city of Santa Cruz is planning many interesting excursions both by land and sea. Special reduced rates will be given by the railroads.

The

41st Annual Session

....of the....

California Teachers' Association

will be held at

SANTA CRUZ.

At a meeting of the Board of Directors of the California Teachers' Association, held in San Francisco March 30th, it was unanimously decided to hold the meeting of the California Teachers' Association at Santa Cruz during the week beginning December 30, 1907.

M. E. DAILEY,
Chairman Board of Directors.

California Teachers' Association.

Council of Education.

STATE BOARD OF EDUCATION.

(EX-OFFICIO.)

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E. P. Cubberley.....Stanford
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Jos. O'Connor.....San Francisco
Henry Suzzallo.....Stanford
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SEND NOTICE

OF

CHANGE OF ADDRESS

High School Teachers' Association.

C. L. Biedenbach, President. G. W. Wright, Sec'y-Treas.

Industrial Education.

Dr. E. C. Moore, City Superintendent, Los Angeles.

THE paper read by Dr. Moore is as follows: In addition to the practical reasons for industrial work usually cited, there are two great theoretical reasons why the old-fashioned type of schooling is giving place and must increasingly give place to a better type of education. One is a sociological reason, the other is a psychological one. One is a consideration content; the other of method. They agree in demanding the same sort of a reform.

The social necessity that forces us to substitute for the old-fashioned schooling a new content of instruction, is that the lessons that the child learns if he is to develop by them must come from his own environments, from his own age and from the pursuits and activities of his own people, not from a remote environment, another age and another people. If he is to grow up well he must be allowed to be a member of his native community, seeing its activities, hearing about its activities, sharing its activities, comprehending its activities and building his knowledge of the distant world of time and space, of history and geography, upon the foundation of the near world of working and eating, buying and selling, rejoicing and sorrowing.

We have been saying over and over again in parrot fashion, for lo,—these many years, that instruction must proceed from the near to the far, from the known to the unknown, from the obvious to the obscure. But we have overlooked the fact that the nearest thing to us all is the work that men are doing all around us and the remotest thing the work that men did in the most distant days. We have overlooked the fact that the thing that is known is the life of activity about us, while, except for its help as an interpreter, the life of the past need not even be understandable to us. All rich and potent education must lay its beginning in and proceed from a knowledge of the activities of one's own time.

What method will enable one to familiarize himself with these activities—to know them? The psychologist answers "learning is a motor process." It is the things that one does that teach him; not looking at books or listening to lectures. They be only supplementary process. It is only the farmer boy who has cleared the land and held the plow handles as it was being broken up and sewed it, harrowed it and watched it nervously until it ripened on the stock and then gathered it in, who knows what production is. And there is only one way for the child in school to approximate to his knowledge, that is by going through the same process. And if one would know what manufacture and distribution mean he must make their acquaintance in the same way. So that in addition to the consideration that working studies fit one to undertake the work of life we have the further very significant reasons for studying them that they supply the beginnings of all knowledge and that they alone can be learned in the most profitable manner.

Knowledge, of course, has two parts or sides—doing something and thinking about it or practice and theory. In the earlier days most boys and girls had plenty of opportunity at least for the doing and sometimes even for both. They worked on the farm and went to school or they served as apprentices and learned trades nights and mornings and while doing so went to school in the day time. But machinery and the growth of towns cut down their work on the farm and the coming of the factory system robbed them of opportunity to learn trades by the apprentice methods. The doing side of education became smaller and smaller and the school book or listening and looking side increased until it finally stood alone as the only means of training.

HOW FRENCH DO.

The superiority of the French exhibits at the World's Fair at Paris in 1867 called attention to the superiority of their school training and led a number of prominent citizens of Massachusetts to petition the General Court of the state that inasmuch as "every branch of manufacturers in which the citizens of Massachusetts are engaged, requires, in the details of the processes connected with it some knowledge of drawing and other arts of design on the part of the skilled workmen engaged," and at the present time no wide provision is made for instruction in drawing in the public schools, our manufacturers, therefore, compete under disadvantages with the manufacturers of Europe; for in all manufacturing countries of Europe free provision is made for instructing workmen of all classes in drawing. For such reasons we ask that the Board of Education may be directed to report, in detail to the next

Grand Court, some definite plan for introducing schools for drawing or instruction in drawing, free to all men, women and children, in all towns of the commonwealth of more than 5000 inhabitants."

The legislature replied by making drawing a required study in all the schools of the state. It was put in to serve the needs of industrial life. New school masters soon made it a merely culture study and the very people who had asked for it began to look upon it as a fad. Some years afterward manual training was introduced with exactly the same result. "The overmastering of influences of school traditions have brought into subjection both the drawing and the manual work," is the report of the Massachusetts Industrial Commission.

It is said that Bismarck inquired of the officer in charge of the German exhibit of Philadelphia in 1876 how the German goods compared with those of other countries. "Our goods are cheap and wretched," was the reply but since that time Germany through her technical schools has put and kept herself in the foremost place in Europe. And no matter how successful we may have been in competing with her in production, we have fallen far behind her in point of technical education and in the industrial training of our people. In this superiority over us she possesses a national asset of incalculable value which we must reproduce if we are to hold our own. The great change which she wrought in so short a time can be wrought in our educational system also.

SHOULD APPROXIMATE LIFE.

At present our industrial training in elementary and secondary grades is far from satisfactory. In some places we have manual work in all the grades. We have in Los Angeles. But the character of the work we are doing is far from satisfactory to any of us connected with it. My own view of all this work is that it should approximate as nearly as possible to the work of every day life. It is not enough that children be highly interested in it and make wondrous products by it. And it is not enough that the exercises are such as according to an ancient and outworn psychology are well suited to train their faculties. In addition the knowledge they are learning should be such as they will have occasion to reproduce in late life. By way of illustration, manual training may take for its prime object the work of teaching boys how to use the saw, the hammer and the plane; it may seek to impart the primary principles of carpentry. Its work may be upon large pieces for real and immediate use in the school room or the home. Or manual training may be of quite another sort. The manual training instructor may fill his work room with a great variety of tools, more than any well

equipped carpenter ever has occasion to use, and then he may allow his boys to use the plane where they should rely upon the saw or the straight edge where they should use the plane. He may systematically unfit them for work with the fundamental tools by thrusting the accessory tools into their hands all the while. He may keep them at work on dainty little insignificant pieces which are only toys in their proportions and in their utility until they are actually afraid of a piece of wood more than a foot long. He may try to teach the fundamentals of carpentry. He may take them over a course of magnificent and tiresome models and turn them out at the end with a well established hatred of tools and tool work. And this he is pretty sure to do if his own knowledge of tools and manual training has been derived from a six weeks' course of instruction at Naas or 120 hours of shop work in some American manual training normal school. Now the same is true of cooking and of sewing.

EDUCATIONAL FETICHES.

Manual training is a fetich. The time has gone by when we should worship all kinds of it. We must ask not for manual training but for a certain kind of it—the education kind. Some manual training is worse than no instruction at all. Some of it on the other hand is the best form of instruction which any school can provide.

And the same I think is true of polytechnic instruction also. I mean polytechnic instruction of secondary grade. What is the purpose of the polytechnic school? In the first place the polytechnic high school is not a technical college. If it undertakes to make engineers and technical experts and to impart the whole round of technical instruction in four years, a thing which the college finds difficulty in doing in eight years, it will lower the standards of technical education, debase the product and exist in a measure on false pretenses. There is no provision in our school law which permits it to add one of two post graduate years to its course. There is indeed no provision which enables any high school to add post graduate work to its course. The people have taxed themselves to provide instruction of college grade elsewhere and as the higher education is getting its full share of the school tax now it is not likely that it will permit secondary schools to draw money for college instruction since the money they would use would of necessity be taken from the lower schools. I conceive therefore that the polytechnic high school is not and is not going to become a technical college. While it would be much easier for it to occupy this field already worked out and well defined, than to work out a field of its own, it

must instead, I believe, bend its energies to working out a field of its own.

POLYTECHNIC HIGH SCHOOLS.

There is a distinction between the manual training high school and the polytechnic high school. What it is I don't quite know. I am going to say that the manual training high school is just an old time high school with a manual training work which a student in any course may elect to take along with his Greek or his Latin or his old fashioned mathematics, if he wants to. The polytechnic high school on the other hand is a secondary school, all of whose work is undertaken as a training for technical activity and modified re-hash to accomplish this end. The polytechnic school differs from the monotechnic or trade school in that the latter, the trade school, undertakes to impart the knowledge of single trades as thoroughly as that knowledge can be imparted by school instruction. The polytechnic school on the other hand endeavors to impart a larger knowledge of the theory of groups of related trades and somewhat less specific instruction and practice in any particular one of them. The polytechnic school is a trade school, in that all of its work is undertaken to prepare for technical activity. It is conceived that the character of the polytechnic and the trade school is really much nearer identical than is commonly supposed. One of the chief objections of trade unions to trade schools is that they profess to turn out finished workmen, a thing which comes from following a trade under commercial conditions. Educational consideration lead to the same conclusion. "Please take notice," says Sir William Mather, one of the chief English experts on industrial education, "of the avoidance of teaching a trade to the extent of causing a lad to say after leaving the industrial school, 'I am a printer,' 'I am a cotton spinner,' 'I am a mechanic or a carpenter.' In the first place it is detrimental to the lad's own interests. He becomes somewhat conceited before he has got through with the proper training by actual practice.

"It tends to deterioration of skill and intelligence in trades, which can only be fully acquired through work done on a commercial scale. It will tend to discredit industrial education."

SERGEANTS OF INDUSTRY.

This puts the business of the polytechnic school in a nutshell. It exists to provide sergeants for the great army of industry, managers, and foremen of works. The foreman must have handled the machine, he must know the elements of the trade. Hence the polytechnic school must teach the trades

for which it expects to turn out foremen. But more, the foreman must know his trade, not by rule of thumb or by imitation, but scientifically. For illustration there is a difference between a puddler and a good puddle boss. The puddler should know how to work iron. The boss should know the chemistry of it and how to add and subtract ingredients in order to make it of the right quality.

SUBJECTS TO BE APPLIED.

And that the work in the high schools be modified so that the instruction in mathematics, the sciences and drawing shall show the application and use of these subjects in industrial life, with especial reference to local industries, so that students may see that these subjects are not designed primarily and solely for academic purposes, but that they may be utilized for the purposes of practical life. That is, the algebra and geometry should be taught in the public schools so as to show their relations to construction; botany to horticulture and agriculture; chemistry to agriculture, manufacturings and domestic science; and drawing to every form of industry.

It is the business of the polytechnic school to lead the way in these things. Everything that it teaches must be taught polytechnically. It must teach trades and to teach them it must teach applied mathematics. The old kind won't do. Applied physics; the old kind won't do. Applied chemistry; the old kind won't do. Applied botany and biology; the old kind won't do. Applied history as the history of commerce or industry and applied languages, the language of commerce and technology. The polytechnic school should look very different from the ordinary high school. But instead of the real thing we have only pseudo polytechnic schools in our county as yet. In most respects their courses are hardly distinguishable from those of the literary high school and even our trade schools keep relying more and more upon the old book studies of their course and less and less upon their own constructive work.

The French and Germans must be our leaders and furnish our models for this kind of work.

Department of Music.

E. J. Nesbit, President. Lida Lennon, Secretary.

Public School Music from the Voice Teacher's Standpoint.

Mrs. Don Pardee Riggs, Fresno.

AT this time of the year we all take pleasure in picturing the scenes that took place at Bethlehem at the beginning of the first year of our present era.

How we have all followed Lew Wallace's descriptive lines in Ben Hur through the opening scenes. What a sympathetic thrill do we feel with the wise men when they behold "The Star," and then we travel on to that little town where we see the rock hewn stable, while just over the hill, a little way beyond, we can see the white and frightened faces of the shepherds peering out from the marah (sheep cote) as they watch the wonderful light, which grows to an intolerable brightness, dropping from the sky as from a window, and from out this light we hear the voice of the herald, "Fear not," and then that ringing glorious chorus of angel voices, "Peace on earth, good will to men." So our present era was begun with song, a song of praise. Some one has said "The power of music enters into the heart and soul and moulds the character of man." Let us see if this be true.

Music is the language of emotion while all other art is intellectual. Do not understand by this that there is no intellect in music. For the composer and the interpreter there is great intellectual effort, but to the listener or to an audience in attendance on a concert it is only an emotional feast.

We are made to feel happy, sad, soothed, or roused to battle by the music to which we listen.

Our lives and acts are more or less controlled by our emotions.

We are all aware that even a limited amount of correct musical knowledge brings endless enjoyment to the home, is a great moral influence in the community and may be a source of untold good along religious and civic lines.

Knowing that emotions play so important a part in our

lives, and that music is emotional; that it has the power to influence for good or evil; can we not then comprehend the importance of using this force in the training of our youth?

It is my belief that a greater amount of good would be accomplished by striving to unite the work in the schools with that of the private teacher.

While the work is wholly from a different stand point yet each is necessary to the other. The school work has not the making of artists, but is the preparation for such training. ***Musical sense***, ***musical appreciation***, ***knowledge of intervals***, ***good literature***, ***interpretation***, and ***sight singing*** are the several links that will help the student that wishes later to follow music as a profession. Just as the piano teacher has laid down as the most important principle the necessity for the formation of a fine touch, so singing teachers rely upon the culture of a fine tone in order to teach singing well. The first step in this direction must be the care of the speaking voice. It would be hard to say too much on this very important point.

One of the professors that Fresno once had in her schools, accomplished wonders with his class, and never once did he speak to us about our habits of speech. Whenever he came before his class it was with smiling face, and his voice so low that the first sentence was generally lost. Immediately a hush fell over the room, not a book or paper moved. Concentrated listening was the result. In a moment we were able to hear him distinctly. At the end of the year the entire class spoke with well modulated voices.

I also took notice at this time, that in passing through the halls I could hear distinctly every word of instruction that teachers were giving their respective classes. The result was, shouting children, and generally speaking, bad deportment.

Another thing which is worse to hear, these teachers were not overly well liked by their pupils. This may not have been the cause of this. But the hard loud voice is not conducive to pleasant thoughts from the listener. A good motto, I believe, to adopt would be what Mr. B. J. Lang once said to me, "Always cultivate love in your voice."

The child until it is three or four years of age is practically deaf to tone. It is important that the ear should be trained as soon as the sense of tone asserts itself. This ear training is one of the most difficult things we have to handle in class work, for among the lower classes, especially foreigners, we have the monotone to battle. This important work should begin in the kindergarten with truly kindergarten methods. Employ musical toys of every description, the cries of fish-men, rag-men, newsboys, the singing of birds, blowing of mill and train whistles, in fact anything that may

come under the child's immediate experience and observation. Have them distinguish the difference in quality, as bell from whistle, mouth organ from flute, etc. Then difference of pitch is noted in the tones of a series of bells, of a xylophone. Let them build the scale by filling water glasses.

For the beginning of interval study I would recommend the singing of the child's name in octaves, fifths, thirds (care should be taken to adjust the key to the individual voice), having the child answer to the same interval and invert the interval. Ask the class to repeat in chorus the same exercise. When this has been accomplished on the tonic triad, try then the intermediate intervals.

By appealing to the child's fancy by lessons of this kind, the alert teacher will be able to reform the confirmed monotone.

Continue this ear training by singing a phrase of some very familiar song with the syllable la or loo. Then learn if the class recognizes the song from which you have chosen the phrase. The eye should have its share of drilling in conjunction with ear training.

Draw a staff on the board, write the intervals used in calling the names, and these short familiar phrases that are sung on this staff, write *do* with colored chalk. After the class has gained a clear impression of the intervals from ear and eye stand point, sing a very short phrase to them, have them repeat it after you, and then let them write it on the staff at the board.

Rhythm for primary and second grades may be taught by the clapping of hands or the beating with sticks to exercises of various rhythms. Simple songs with gestures, such as bell songs, swing songs, rowing and marching songs will awaken the child and make rhythm a part of his life. The higher grades may be taught rhythm by continuous running circles varying in size according to accent as Oo Ooo.

Mrs. Frances Clark of Milwaukee employs a highly ingenious way of teaching rhythm by the pressure (not tapping) of the third finger on the strong beats of the measure. This finger not being so highly developed muscularly by constant use in writing, drawing, pointing etc., as the second one, feels the sensation of pulse beat of rhythm. These higher grades should be given the relationship of key, key signatures, and sight singing All the songs should be learned with syllables until these songs have reached the point where modulation is frequent. Then the syllables may be laid aside and give place to the words.

A word of advice from the voice teacher's standpoint will at least prove of benefit to voices under your control.

Exercises such as scales and broken chords should be sung mostly downward (explained.)

Encourage boys of fourteen and there about to sing falsetto rather than forced low tones.

Unfortunately the majority of voice placers in this country are either not musicians or are carried away from the object of the song composer by the great interest they take in the fine production of solitary tones. It seems not to concern them in the least which way their pupils drag through passages, ignoring rests, destroying the phrasing and becoming perfectly oblivious of the object of the song composer, while disdaining his breath marks and tolerating the impossible enunciation and careless uneven delivery thereby ruining the phrases musical and poetical.

All this that I have criticized the private teacher for may be taught in the school room.

Choose songs that have well selected words. And teachers! The regular class teachers! You may have a limited knowledge of music (since our schools in California thus far have been lax in their demands in examinations in music), but there is no excuse for the poor reading or the selection of songs that have words of no literary worth.

Create color and life in the ideas sung—marks of expression may be absolutely followed, but the very thing these marks are supposed to bring out will have failed if the appreciation of their intentions are not realized—at this point the effect of facial expression may be explained.

Let the class realize how ridiculous it would be to say "Oh, I am so happy!" with a long face, or "I am so sad," with a smiling face

Read the words of a song with varied accent. Have class express the meanings of a phrase with this changed accent.

Tell them amusing stories, as "In Othello," where the hero, torn by jealousy, imploringly asks Iago concerning Cassius, "Is he not honest?" Whereupon, Iago responds half quest, half doubtingly, "Honest, my lord." But an amateur once responded, with conviction, "Honest? My lord."

When you have gained an intelligent reading of the words of a song, compare the accent and diction to the musical setting.

The pupil must understand that it is the words that inspire the composer to write the music.

For clear enunciation—

Do not understand certain words of phrases—"What kind of a night did you say?"—"Where are you going?"

Teach rounds for part singing, this requires concentration.

Demand watchfulness of your movements for attacks and expression. Surprise them by doing the unexpected. And with

all study of music make your class feel *you are happy—make them happy.* For this is the secret of youthfulness in the voice—*the pearl of great price to all singers.*

Public School Music from the Publisher's Standpoint.

Selden C. Smith, San Francisco.

I PRESUME that some of you in reading this have said to yourselves that there is but one point of view that the publishers have in considering this question, and that is the amount of cold cash that can be taken by them from this department of public school work. You might also say that every person engaged in the teaching profession is working for the money they can get out of it. The same thing could doubtless be said of the great majority of lawyers, doctors, ministers, architects, politicians, and people generally, but I like to think, and I surely believe that the lawyer, while not refusing the fee, desires above all else to see that his client gets a square deal; the doctors, although charging for each call more than the lives of many of us are worth, have as their ideal the hero of McLaren's "Beside the Bonnie Briar Bush;" the ministers, while generally listening for a higher call in the way of salary, are above all else interested in bettering the condition of their fellow-men; architects, especially since the eighteenth day of April, have decided to see that buildings are constructed more honestly; teachers, while more interested in the question of "A Raise in Salary" than in any other question that could possibly be placed on an institute program, are ever ready to forget it and give their lives to the making of better men and women, and while I do not wish for a minute to have you think that publishers are moved wholly from philanthropic motives, yet I do believe that they may be classed right in with the hard working men and women teachers and supervisors as one of the greatest forces that keep public school music improving year by year.

There is something about music that appeals to the average business man as no other subject in the school curriculum. His memories of R., R. and R. are not always of the most agreeable nature, but with music it is different. Music is an art. Business as conducted to-day, and so far as I know as always conducted, is a cold blooded proposition. It is for the most part a case of natural selection and survival of the fittest.

What is your gain is the other fellows' loss, and to off-set this every business man who comes to a position of affluence likes to contribute his share to the sum total of artistic uplifting influences that are at work in the world. Public School music furnishes the publisher one of his greatest opportunities.

Every teacher, who is of the right sort, following the example of the Great Teacher, is ready and willing to give to his fellow teacher the benefit of any methods, plans, devices or material which he has found helpful in his own work. This can be done at County Institutes and at meetings like this at a slight cost, but to do it on a large scale is very expensive and costs much more than most teachers could afford to expend. Right here is where the publisher comes in, and I leave it to you to judge whether his work along this line alone is not of inestimable aid to the cause of public school music generally.

The successful text books, as every publisher knows, are not those written to order, but those which are the outgrowth of years of school experience. Unfortunately, many times when the personality of the would-be author is absent in the presentation of his plans—and there is nothing but the cold pages of the book to lean upon—these plans which worked so beautifully fall flat and then it is that the publisher becomes what is known as an "angel" in theatrical parlance.

The struggle for existence which public school music is having to-day is but a repetition of the struggle for existence which music generally has had from the earliest times to the present. I do not dare tell you how many Boards of Education have told me that while music was all right, its introduction into the schools would cause unnecessary expense, and these penurious Boards of Education are ably backed by the lazy and ignorant teachers who say "there is no place for music in our course of study which is so overcrowded."

I believe that I am not alone among the bookmen as one who has always taken great pleasure in showing Boards of Education the slight cost at which the most delightful of all subjects may be introduced, and in helping more than one teacher to see that music instead of adding to the burdens of the course of study in reality acts as a means of relaxation and lightens the work of the pupil. Thus, while there may be more dollars and cents in readers, geographies, and arithmetics, a love of the subject of music has led many a bookman to lay much more stress upon this work than the financial return will warrant.

A third way in which the publishers have been able to help along this work greatly is by means of their summer schools. Here again none of them would claim that these schools are organized and run from purely philanthropic motives, but were it not for the publishers, schools of this kind would not

be possible in that they are conducted each summer at an expense much greater than the receipts.

The cost to the pupil in attending one of these summer schools is merely nominal, while he has the benefit of instruction from the best and most successful teachers in the land.

In closing allow me to make one or two suggestions as to how each one of you may be of untold assistance to the publishers in their efforts to do something to help along the cause of public school music.

Whenever you work out some helpful plan or know of someone who has done so, just put the publisher in touch with it, so that he may bring the good news to the attention of others.

When you receive from the publisher a new book, don't hesitate to write or tell him what you think of it, no matter whether your opinion be favorable or otherwise If favorable it will encourage the publisher to bring the work to the attention of others If unfavorable be definite in your criticism and you will help greatly toward the revision of the book or cause something more meritorious to be placed on the market.

And last but not least, do not hesitate to tell your Superintendent and Board of Education about the good that you see in the new books as they appear from time to time No teacher who is capable and honest need hesitate in demanding the tools with which he can secure the best results. A carpenter or blacksmith would be ashamed to do less. Insist that the rights of authors and publishers as conserved by the copyright laws of our land be not infringed upon nor allow your own strength to be taken in copying songs and other material which should be furnished to the pupil, by standing firmly for what you believe to be right; the publisher, no matter whether you recommend his books or not, will respect you, and your Board of Education will soon acquire the habit of giving you everything asked for.

Music from the Standpoint of Supervisor.

Ida M. Fischer, Director of Music, State Normal School, San Jose.

THE work of music supervision is distinctly separate from any other branch of the music profession, for a supervisor should be, not only a competent all around musician, but also a good teacher and organizer, should understand the underly ing principles which govern instruction, and possess the skill to impart knowledge. He must know the child and child life and how the best results are obtained in other subjects so as to be able to plan the work along the same lines. Added to this,

a supervisor must have the power, through love, appreciation, and enthusiasm for this art, to inspire the class and the teacher as well as to put forth their best efforts.

While the hearty co-operation of superintendent, principals and teachers with the supervisor is necessary, yet the real progress of the class is due to the class teacher. With the teacher in harmony, the chord of hope is sounded.

It is best not to expect too much at first for many teachers are not well equipped for the work in music. Indeed, this is the one subject in which the average teacher feels the need of much help and encouragement. Often, through the aid of an efficient supervisor, the teacher who would otherwise entirely neglect music develops much interest and gets fine results. Generally any teacher strong in other subjects can do good work in music under proper guidance.

An erroneous opinion still prevails in many places that music in the public schools is intended simply as a means of recreation, whereas, if made practical, it is a study from which as many if not more benefits may be derived than any other. We must prove unquestioned the utility and far reaching benefits to mankind which a knowledge of music confers by making the results achieved compensate for the time and money expended.

There should be a general working together of the mechanical with the artistic sides in such a way that neither will be neglected, topic following topic in the most natural and progressive order. Children must be taught to love good music by constant association with it, so as to be able to discriminate between the good and the bad in music. They should be trained to sing with unstrained, pleasant voices, freed from disagreeable qualities,and last they should be qualified to read music, thus creating in their minds a desire for more advanced work.

Wishing the opinion of other supervisors regarding what they thought of most importance in our work, I wrote to several and received the following replies:

"I will mention a few points which appeal to me in teaching and supervising.

1. Hearty co-operation of supervisor and teachers
2. Supervisor's presentation such as will inspire teachers and call forth best effort
3. Broad outlook upon world in general and the musical field.
4. Sympathy with and appreciation of child life.
5. Best of available material used.
6. Elimination of much mechanical work.
7. Spiritual and formal sides to be considered.
8. Musical impulse and imagination constantly appealed to.

9. Developing character and stimulating the spiritual through fine poetry and beautiful music.

10. Knowledge on part of supervisor, teachers, and pupils of what is sung, why and how.

11. Listening by teachers and pupils to high grade music by best artists available.

12. Faculty of appreciation developed.

13. Some knowledge of great masters and their works.

14. Creative work encouraged.

15. Music should make us more intellectual, loving, reverent, patriotic."—Mrs. Gertrude Parsons, Director of Music in High School, Los Angeles.

"The greatest problem and probably most important is the means whereby the older boys and girls may be made more interested in the music."—Milton S. Lawrence, Supervisor of Music, Los Gatos, Cal.

"As an important thing, I would suggest, pupils should be taught to *do for themselves* in music I mean, to be able to *read at sight* and to give the right interpretation or expression to the *thot* in the song. Too many children depend on the supervisor or their teacher to *inspire* them or to help them over many things they should be able to do *alone* If we *teach* them properly, they will be able to do things for themselves before they leave the grades"—F. F. Jeffers, Supervisor of Music, Palo Alto, Cal.

"Briefly, I think, an important thing in our work is to interest pupils in the broad side of music; to awaken a serious interest in the subject as a whole; instrumental, orchestral, vocal, history, etc. If we succeed in making the children love it, love the good and beautiful, appreciate the artistic, desire to study it, and learn more of it for its own sake, I think we've done nobly for the cause. This to me is of the greatest importance, and I think will mean most to the individual"—Kathryn E. Stone, Supervisor of Music, Los Angeles.

"Of most importance in the music supervision is the power to get the hearty co-operation and good will of the teachers."—Estelle Carpenter, Supervisor of Music, San Francisco.

"You ask me for suggestions as to the work of a supervisor, and I gladly reply.

1st. The supervisor should be well educated along all lines, that he may be able to hold his own in all matters of educational work that may arise for discussion.

2nd The supervisor should be an artist in the subject under his direction, as well as an expert teacher in every particular.

3rd. He should be broad enough to see the relation of his own special subject to the entire course of study and be able to skillfully correlate his work in a way that the greatest good shall be done to the greatest number.

4th. The work of the supervisor can be made effective only so far as he is supported by the superintendent, principals, and grade teachers There must be a perfect bond of sympathy between them, and all must work for the common good of the children.

In the subject of music, every phase of human experience is touched. The object being to try to bring about a better musical atmosphere in America, to create a musical environment in every home and to aid in the development of a national type of music.

This can only be done by giving to every one such training as comes thru our efforts in the public schools.

To do this work well requires that it should be of such a nature as to be beyond criticism, in other words it must be excellent, even artistic, and this must come through the aid and direction of those who are thoroughly trained for this work.

The work of a supervisor who does his or her part as is expected, and as completely as is the opportunity afforded, will give to the world at large, and especially to those who come under their guidance, a legacy that will be of infinite value throughout all time and eternity."—Hamlin E. Coggswell, President Music Section, N. E. A.

Regarding the general situation, we have reason to be encouraged. The cause of music is steadily moving onward. Still there is much chance for improvement, especially in the district and small town schools where it seems impossible to have supervision. Music means much to these children. Many would never hear music of any sort, would never have the spirit of song enter their hearts if the opportunity were not given in the school. How can the music be brought to them all? In my opinion, by a more thorough preparation for its teaching.

Only when music is continued well graded from the Kindergartens on through High Schools, Normals, and Universities as other subjects are, can we expect it to be well taught throughout the state.

Let us not be satisfied until the best instruction and the best class of music shall prevail everywhere. Then the real benefits which music can give will be felt.

We are all working together for a common cause with one grand object in view, the uplift of music in the state. Let us unite our forces, for in union there is strength. Let us bring the spirit of song into the heart of every child that there may be singing in the home, the school, everywhere. May all the people in this state that we love so well lift up their voices in song, and thus make this not only the land of sunshine and flowers but also of song.

Department of Science.

A. N. Sheldon, President. A. G. Van Gorder, Secretary.

Optics by the Wave Method.

By A. L. Cavanagh, Los Angeles High School.

DURING the progress in the development of the teaching of Physics, Light seems to have been side-tracked and so has come down to us as a sort of heirloom of the long ago. Our Geometry differs as much from the Geometry of Euclid as this treatment of Light differs from that of the Arabs.

The caloric theory has altogether been displaced by the Kinetic theory and this substitution has passed into history. The "projected particle" theory is being displaced by the wave theory and this is history in the making. In fact, the only thing left to do to complete the transformation is to modernize the teaching of the elements of the subject. The belief that this change will soon be brought about is strengthened by the recent arrival of text-books which attempt to treat Light as a wave phenomenon.

It would be interesting to know how many of the Physics teachers have made a careful study of the two methods in Light and of these how many have been converted to the new.

In the few minutes given to this subject, I want to tell you what my experience has led me to believe after teaching both methods during the past five years. I have been asked to talk on this subject and in dealing with it I give my views not with a feeling of antagonism toward any one but with a wholesome respect for those who think differently after careful comparison of the two methods.

I know well the difficulties that a student must meet in attempting to acquire—if he should succeed at all—a true understanding of light propagation by the study of rays which points the immature mind only too surely to the antiquated theory. In fact, it is only after a study of Optics with "rays" left out that I have come to feel that I understand what I am trying to teach them. An image of the wave ought always to be uppermost in the mental picture.

I believe the method in geometrical optics to be unsound.

I make this statement emphatic in order that my position may be understood. Some of my reasons for giving up the study of Optics by rays are here enumerated:

1. The method is unintentionally misleading. However good the intentions of the teacher may be, most students are left with a hazy understanding of the subject, at best, because the bald facts are not kept constantly before them. In the mental picture the ray is substituted for the wave, which condition is not true to nature as we know it.

2. The method is too apt to leave the mind with a seeming explanation of Reflection by the rebounding ball idea—projected particles. The rays are bent at the reflecting surface for the same reason that the path of a billiard ball is changed abruptly when the ball rebounds from the cushion and the angle of incidence is equal to the angle of reflection for a similar reason.

3. The meaning of Refraction cannot be made clear nor is the reason for it evident. The use of trigonometric functions before they are understood is undesirable because it obscures the main idea. This is true of any process that takes the mental effort away from the main facts.

4. The study of rays does not lend itself so advantageously to the cultivation of the imagination as does the study of waves.

Every teacher must needs paint mental pictures for the student showing how the disturbance from any source travels outward in all directions and the light and heat we receive from the sun is just the small part of the whole that the cross-section of the earth is of the area of a sphere ninety millions of miles in radius. In brief, our first endeavor is to aid the student to imagine these growing spheres which represent the propagation of energy not only from the sun but from any body radiating heat and light. From this point of view can be developed practically all of Optics. Even so much as the mention of the words ray, pencil, etc., here are ill-advised because of the tendency to obscure the true facts. Insist on the word radius instead of ray and translate everything in terms of these spheres and so keep this idea uppermost.

In terms of spherical surfaces, the law of inverse squares as used in photometry is easily understood. And I find reflection and refraction to be no more difficult of explanation. Let us at least try to give a true conception of reflection. The bending of rays and the production of these to intersect for the purpose of locating the virtual image have their shortcomings. Why do the rays bend as they do? Why is the angle of incidence equal to the angle of reflection? Is it because a tennis ball rebounds from a wall in some such manner? We expect the student to be satisfied with an answer

that is no answer at all. Let us encourage intelligent questions and give as intelligent answers as we can.

We cannot build without axioms from which to begin. The axioms of the wave method are simple and reasonable. In fact they are accepted, in different words, in the older method. These axioms are: 1. Any object is seen at the center of curvature of the energy waves we receive from the body. 2. These waves are approximately spherical in a homogeneous medium. The second is implied in the first but is here stated for purpose of construction. The second must needs have limitations.

When a wave-front falls on a polished surface it is reflected as a wave-front. Its velocity may or may not be changed by being turned back. If the velocity isn't changed it is evident that the curvature is reversed but not changed in value. It will seem to be coming from a point back of the reflecting surface and this point is the image of the true source. In a plane mirror the object and its image are equidistant from the mirror. If the velocity were changed by reflection, the curvature of the reflected wave would be changed and the image would appear either nearer to or farther from the mirror than the object is. In this way nothing need be said about angles of incidence and of reflection.

The construction is equally simple for reflecting surfaces of any form so long as they are spherical because a drawing represents a cross-section only. I find that the students make these constructions with little assistance and many of them with no assistance at all. This, of course, after the construction for the plane mirror is understood.

Having no text-book this year, I assigned many of these constructions as "originals." I had them use a slanting arrow as object and follow waves from each tip of the arrow and so obtain the position, size and slant of the image. I found many of them could do this correctly though they had no reference books or old folders from which to get suggestions. The following figure will illustrate the method when the mirror is convex.

In figure 1 AB represents an object in front of a convex spherical mirror MN. The sperical wave fronts from A and B are reflected from the mirror as spherical wave fronts which to an observer anywhere in front of the mirror, appear to come from A′ and B′ respectively. Since these points behind the mirror are not true sources of light waves, A′B′ must be a virtual image of AB.

The WHY of things is more evident with the method of waves. I have seen students locate images at certain places "because the rays crossed there." The meaning of the crossing of the rays was lost. If the waves are drawn, it will be

seen that where the rays cross the wave-front contracts to a small area or focuses. If a screen is held at this place, a point on that screen receives all the light starting from a par-

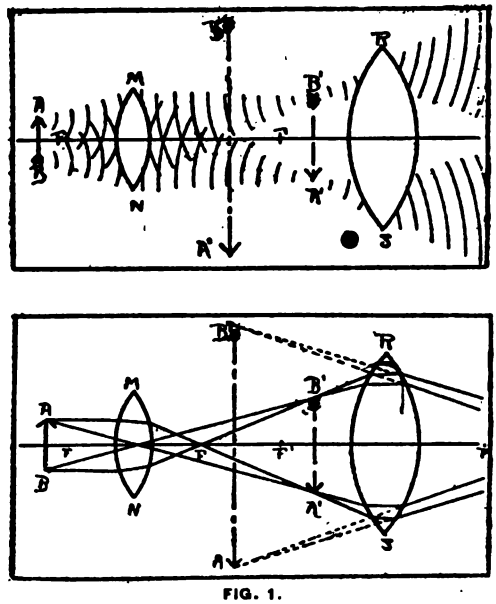

FIG. 1.

ticular point in the source and reflected by the mirror or refracted by the lens. This is the condition necessary for the formation of a real image.

Again, a coin in a dish of water appears nearer to the surface than it actually is "because the rays are bent from the normal and, when produced, the virtual image is located at a point higher in the water than the object is." This doesn't explain the bending of the rays and so the explanation is not satisfactory. As a matter of fact, the reason is quite easy to see in terms of waves. The wave travels faster in air than in water so the wave-front upon emerging from the water becomes more convex which makes it appear to come from a point higher in the water.

There is no reason why the wave-method should be avoided because of the difficulties in its presentation. This year our text-book consisted of laboratory notes which I purposely made rather full. However, the figures were not drawn for the students, and only suggestions were given to outline and facilitate the work. I had them draw the figures before they knew what they were to find and in this way they arrived at the conclusions which were later verified by experiment. The

work on the whole was a pleasant surprise to me. Refraction offered no more difficulties than did reflection.

Refraction is not a bending of the rays any more than reflection is. Refraction is the changing of the shape of the waves as they pass from one medium into another when the velocity of light is different in these two media and the change in shape is due to the change in velocity as is easily seen. If the velocity of light waves is different in two adjacent media, the wave-front in passing from one into the other must, in general, become more or less convex and this will cause the source to appear either nearer to or farther from the observer, depending upon existing conditions.

The measurement of the refractive index becomes a simple and easily understood problem from this point of view. The trigonometric functions are unnecessary, which is certainly a point in its favor. My construction for this is essentially that given in the text-books, though I believe I have simplified the explanation somewhat.

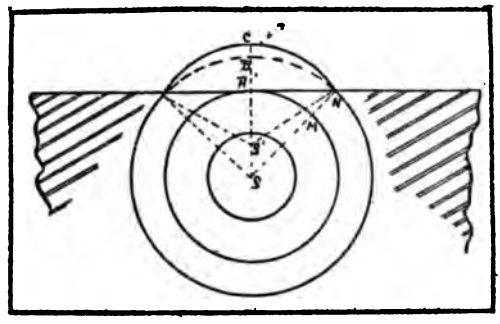

FIG. 2.

In the figure, S is a source of light in some medium other than air. As seen by an observer, it appears to be at S′. The waves emanating from S are spherical until the surface is reached where the curvature becomes more convex as shown by the approach of the virtual image to the interface. The virtual image S′ is the center of curvature of the waves in air.

It is evident that while the wave-front has been growing so as to increase its radius by a distance MN in the denser medium, in air the radius SA has been increased by an amount AC. That is, the wave travels a distance of AC in air in the same time that it would require to go a distance MN in the other medium. Whence

$$\frac{\text{The velocity of light in air}}{\text{The velocity of light in the other medium}} = \frac{AC}{MN} = \frac{AC}{AB} = RI$$

By this method the Refractive Index comes to be intelligible when expressed as a ratio of velocities rather than a ratio of the sines of angles. It becomes a simple task to measure this constant for any transparent substance. For liquids I use a rectangular battery jar and the results are decidedly satisfactory.

The effect of lenses on the shape of the wave-front is readily understood. It is evident that a wave-front in passing through a lens is retarded by the glass and that part must be retarded most which goes through the most glass. So if the lens be convex, the wave-front is made less convex; if the lens be concave, the wave-front becomes more convex on passing through the lens. The same simple reasoning applies to the prism.

One of the most difficult things for a student to understand is the arrangement of lenses in the compound microscope and telescope. Here the drawing in of the waves at different places makes the explanation sufficiently plain. Compare the two following figures to illustrate this point. One is drawn entirely with rays and the other entirely of waves.

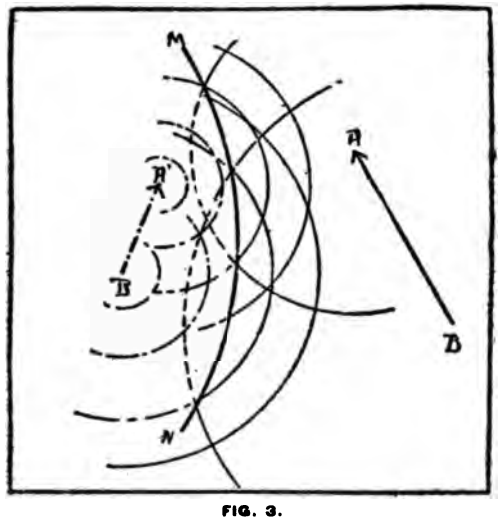

FIG. 3.

In the figure AB, the object to be reviewed through the compound microscope, is placed just outside the principal focus of the objective. The waves from A and B, after passing through the lens MN are concave and focus as shown at A′ and B′, respectively, so as to form the real image A′B′ within the principal focus of the eyepiece RS. The image is inverted and enlarged. The real image being a source of

light sends out spherical waves which, emanating from points within the principal focus of the eyepiece, cannot become concave by passing through RS but are made less convex. An observer receiving these waves sees an image at the center of curvature of these waves, at A″B″.

The construction seems to interest students, especially those in mechanical drawing classes. The interest is perhaps due to the fact that the compasses are used a great deal more than in the other constructions. As evidence of this interest I have a collection of plates which have been drawn and contributed by these students and this collection is added to each term. It is my intention to have these enlarged for wall charts.

It would be strange if the method offered no difficulties whatever. I believe it offers fewer than the ray method and one of these is total reflection. But the old method seems to be misleading in this particular because it gives the impression that vision is perfect until sine r=1. Let me quote from a letter received from Prof. Sanford touching on this point. He says: "I am skeptical about there being any part of the emergent wave front exactly perpendicular to the surface of the separation of the two media, though it is possible that some scattering light emerges parallel to the surface. I have tried to measure the angle of the refracted ray when it disappears, and I have never been able to get any appreciable light at a greater angle than 89° with the perpendicular to the surface and no object can be seen within several degrees of the surface."

I believe in the wave method in Optics because it leads to and is based on true conceptions; because it is more explanatory in its teachings; because it is more easily understood and retained by the student; because it is more interesting and because it permits of original work on the part of the student.

The method of rays has served its purpose well. But as the undulatory theory has replaced the belief in projected particles, so I believe the constructions based upon that antiquated theory ought to give way to what is at least nearer to nature.

To those who advocate a proper mixture of the two methods I would say that there is danger of confounding the student because of the brief time allowed for the subject. But were I to undertake to give such a course I certainly should begin with the wave method.

There may be those who hold the method in disfavor because it does not lend itself well to quantitative demonstrations. While admitting that definite relations may be obscured by errors in construction by the wave method, I would

answer that in the necessarily brief time allowed this subject in the year's work, I believe the approximations to be obtained by this method to be sufficient.

The Mathematics of Elementary Chemistry.

By J. W. McIntosh, Fowler Union High School.

THE discussion of this subject naturally divides itself into three parts.

I. Mathematics. 1st, from an ideal standpoint. 2d, as it is. 3rd, as chemistry teachers want it.

II. The work done in Mathematical Chemistry.

III. The results obtained.

Some noted educator has given us the following: "Whatever improves the mental powers, strengthens the judgment, and sharpens the faculties to keener discernment; in fact, whatever trains the energies and capacities, directing them to their true ends, tends to culture in its highest and best sense." Many maintain that mathematics, in its real sense, holds the broadest place in this field, particularly as it strengthens the judgment and sharpens the faculties to keener discernments. Kepler exclaimed, that "the laws of nature are but the mathematical thoughts of God." Maxwell said: "All knowledge is founded on the comparison of one quality with another. Knowledge that is not exact has but little value and frequently is a detriment to its possessor."

This is very different, however, from the mathematics as we know it in the public schools to-day. The grade teacher complains because the pupils come to her ill-prepared in their arithmetic, likewise the high school teachers and university instructors. It is probably no exaggeration to say that thirty-five per cent of the pupils fail in arithmetic and a similar ratio in algebra and geometry. From this condition it seems that our schools need men and women who know the underlying principles of mathematics and parents who insist that their children shall think on these things and not upon the next social event of the season.

Most pupils find the solving of new problems very difficult and many find it impossible. The best pupils do the work and the poor ones memorize it. This fact is most noticeable in classes in geometry. In the algebra class the pupils spend entirely too much time looking for the answer. Our leading

educators tell us that we learn from the concrete to the abstract, yet, we teach the abstract mathematics first, then later in their work in physics and chemistry get the concrete. The pupils see little relation between the two, and this is a very difficult matter to teach All teachers, no doubt, have had the experience with students who could not solve for an unknown when it was T. V. or L. but as soon as X was placed for this unknown, they could solve readily.

The old technical grammar was very unpopular. The boys would not study it; now correlation has made English an interesting study. Even so, the English teachers tell us that technical grammar is an absolute necessity to an understanding of the language. Similarly, mathematics is a great aid to the study of science. "It is absolutely necessary to anything more than a superficial knowledge of the subject." The student must learn that the method of solution of a problem is found in the problem itself, when once read and interpreted properly. "Mathematics had its origin in trying to solve practical problems," and is still used by the engineers who are solving the great problems that are benefiting the human race. The chemist is none the less practical than the engineer.

These facts being true, we ask the teachers of mathematics, first, to drill their students upon the correct manipulation of equations, using different letters for the unknown; second, to teach ratio, direct and inverse, proportion, percentage and graphs. Nearly all the problems in mathematical chemistry are in the form of equations, and these equations involve either the direct or inverse ratio. The student must know percentage to calculate the percentage, composition of compounds, and graphs for the drawing of curves of solubility etc.

So much for the value of elementary mathematics and the need of the preparation of the student for the mathematical chemistry. Why? Freer states: "There are two laws that are fundamental throughout chemistry, the qualitative and quantitative relations. One is as important as the other, and should correlate each other." He further states that "An elementary course in chemistry is not to produce a chemist, but to give the beginner some fundamental principles of the science." The California Universities are quite in line with this idea. Stanford favors a thorough knowledge of elementary chemistry, as a preparatory course, while the University of California desires some qualitative analysis in the elementary course, yet, both universities require the solution of many problems to fix the principles. The student doing university work states that the solution of problems is of invaluable help to him as a preparation for the advanced work.

One of the benefits derived from the meetings of this Asso-

ciation is that its members come together for mutual help and instruction, but the greatest benefit comes about by the writers of the different papers presenting their views upon some particular subject that they have worked out in their own experience, giving the difficulties met, their attempts at mastering them, and the results obtained. With this end in view we come to the second point—the work done in mathematical chemistry.

Knowing that there are from twenty five to fifty per cent of the class that have forgotten the above points that the mathematics teacher is requested to fix, in the first lessons, we review these terms and explain the new ones that will be used. The pupils must know, in addition to the mathematicel terms, the words meter, centimeter, millimeter, gram, cubic centimeter, the relation of one gram to one cubic centimeter, a barometer, how it is used, how to read it, the terms pressure, standard pressure, atmospheric pressure, an atmosphere, volume, thermometer, the two kinds, Centigrade and Fahrenheit, and how to change from one scale to the other. The class is now ready to form experiments one and two of Richardson's Chemistry understandingly. In experiment one, the pupils easily read Boyle's Tube Apparatus and see that as the pressure increases, the volume of the enclosed gas decreases. They then state the law from which they deduce a general expression for the volume V, at pressure P, when the volume v, and pressure p, are known. Their solving of a few problems fixes this law. In experiment two, Charles' Law is developed. They see that the increase in volume per cubic centimeter per one degree centigrade is a constant; that taking the volume at the lowest temperature this constant, in the form of a common fraction, is approximately 1-273 of the original volume, or the increase in volume due to the increase of one degree is 1-273 of the volume. Hence it follows that the volume at 1°C=volume at 0°C.+1-273 volume at 0°C.; volume at t°C=volume 0°C. $+t$-273 volume at 0°C.; letting V=volume at 0°C.; v the volume at t°C. the class derived the formula $V=v\ 273\text{-}273+t$ which they interpret as an expression for the volume of gas under standard temperature. This argument is carried farther showing that the volume at 1°C.=272-273 of the volume at 0°C. and at—273°C.=0-273 of the volume at 0°C., so if the law held true for low temperature at—273° C. the gas would occupy no volume, and for sake of convenience the point—273° is called the absolute zero. They discover now a new statement for Charles' Law.

Boyle's and Charles' Laws are now combined into one general algebraic formula: $V = v.\ p\ T. = P.\ t$, where the major letters represent the things that are in the question and the minor letters the things that are given in the problems. Two

or three days are given to the solution of problems to fix this formula.

The student, when performing the experiments, determining the percentage of oxygen in potassium chlorate, the equivalent weight of zinc or magnesium, the ratio by weight in which hydrogen and oxygen combined to form water, sees the need of mathematics and mathematical accuracy to get results. He sees that he must weigh accurately and adjust carefully. He sees that any apparatus may be set wrong and read wrong. When he sees that he must get down to bedrock he gets there. It is then that we begin to get results and this kind of work has its effect in close and logical thinking.

After the above experiment such problems as are found in Newell's Experimental Chemistry and those like the following are given: Find from the following data: First, the percentage of oxygen in potassium chlorate. Second, the weight of a liter of oxygen at standard. Third, a number of liters of oxygen at 27° C. 74 cm. pressure that may be obtained from ten grams of potassium chlorate, knowing weight of the test tube, weight of the tube and potassium chlorate, weight after heating, volume of water displaced, temperature, and the reading of the barometer. At this point such terms as chemical reactions, chemical equations, molecule, atom, molecular weight, atomic weight, Laws of Definite and Multiple Proportions are explained briefly, just enough for the student to understand what has been taking place in the experiments. From this time on all problems are worked directly from the reaction.

So the work proceeds, performing experiments, discussing the subject matter in the text and solving the problems given at the end of each chapter, through a period of five or six months, when one month is given over to the discussion of chemical theories and explanation of the phenomena that they have observed The ground covered in this discussion was well presented last year by a paper from Mr. Baker of Lowell High School of San Francisco.

A short review is now taken of the problems on reaction and explained from the atomic theory. To Boyle's and Charles' Laws is added the aqueous tension correction. The class is now ready for such problems as the following: The formation of carbon dioxide from Calcium Carbonate and hydrochloric acid is shown from the reaction of $2\ HCl + CaCO_3 = CO_2 + CACl_2 + H_2O$ What weight and what volume of carbon dioxide at 27°C. 74 cm. pressure is formed from twenty-five grams of calcium carbonate? How much hydrochloric acid is necessary? How much calcium chloride is formed? Specific gravity of carbon dioxide is twenty-two, aqueous tension at 27° C. is 26.51 mm., combining weight of H=1; Cl= 35.5; Ca=40; C=12. O=16 The students must remember

the weight of one liter of hydrogen at standard conditions.

Next show that from Avogadro's Law follows the statements that the same ratio exists between the specific gravities of gases as exists between their molecular weights; that the molecular weight of a gas is equal to twice its specific gravity when referred to hydrogen, and 28.88 times its specific gravity when referred to air. Knowing the specific gravity of a gas, its percentage composition, the class readily solves for the molecular weight and chemical formula of a compound, such as the following problem A compound which analysis shows consists of carbon and oxygen, 27.27 per cent of the former and 72.73 per cent of the latter The weight of one liter of the gas is 1.97 grams. Find molecular weight and chemical formula.

The Law of Dulong and Pettit is mentioned incidentally in connection with the methods of location of the discovered elements in the Periodic Table. The student sees that the law of Dulong and Pettit only verifies the results for the atomic weights as determined in other ways But the Periodic Law they recognize as being the most wonderful of all. They read with interest the comparison of the predicted properties and the discovered properties of the new elements and follow carefully the arguments upon the location of Indium in this table. Since the specific heat of Indium was correctly determined they see that this element has a place in the table.

Problems on specific heat, electrolysis, and those involving Sanford's formula for the combination of Boyle's and Charles' Laws and the Kinetic Gas Theory are left to the class in physics. This completes the work that is done on combination by weight, and next follows combination by volume. The pupils have learned that two volumes of hydrogen and one volume of oxygen have combined to form two volumes of water vapor, that one volume of H and one volume of Cl combined to form two volumes of HCl, so can understand Gay Lussac's Law of simple volume ratio and the numerical proportion. "The number of atoms* contained in a given volume of a gaseous substance bears a simple ratio to the number of atoms contained in the same volume of any other gas." This, with Avogadro's Law, will enable the pupil to understand the reasoning given for the number of atoms in a molecule of H and Cl. All molecular volumes are equal. The half molecular volume of any gas is the volume which is equivalent to the volume of an H atom. If the teacher use the molecular relation the numbers in the ratio are the co-efficient of a compound and one-half the coefficient of an elementary gas, while in the atomic relation the numbers in the ratio are twice the

*"Atoms" as used in this quotation, would be designed "molecules" by chemists of to-day,—Ed.

coefficient of the compound and the coefficient of the elementary gas, thus in $2CO + O_2 = 2CO_2$ the molecular ratio is 2:1 and atomic relation 4:2, then follows a list of problems such as: Three liters of a mixture in equal volumes of CH_4 C_2 H_2 and CO are burned the products being CO_2 and H_2O. How much O is required and how much CO formed?

Summing up, a course in Elementary Mathematical Chemistry should consist of problems to fix Boyle's and Charles' Laws, Gay Lussac's Gas Volume Law; on reactions, showing combinations by weight, percentage composition, molecular weights, atomic weights, determinations of chemical formalae, drawing of curves of solubility, etc., and study of the Periodic Table. The best lists of problems that I have found are in Newell's Experimental Chemistry and Bradbury's Manual of Chemistry.

The results bear a simple ratio to the student's preparation in algebra. The percentage of those who do satisfactory work of this character is but little less than the percentage of those who do satisfactory work in the other part of the chemistry.*

In the discussion.
Fifty per cent of the class doing excellent work.
Twenty five per cent of the class doing fair work.
Twenty-five per cent of the class doing poor work.

In the discussions:
Fifty per cent of the class doing excellent work.
Thirty per cent of the class doing fair work.
Twenty per cent of the class doing poor work.

Such a course in mathematical chemistry is necessary to fix the elementary principles.

Whitherward in Chemistry?

By H. F. Sheldon, Armijo Union High School.

'TIS indeed a careless mariner, who, in his wearisome journey across the trackless seas, with its treacherous currents and its veering winds, neglects to watch his log and take his reckoning. Experience from many and many a trip across the same water may be his; his traveling companions may have just as much empirical knowledge as himself; his cabin may be full of charts, atlases, treatises on navigation, and encyclopedias of information on winds, currents and general geographic influences—with all these invaluable guides, there

*Figures taken from classes in Stockton High School.

would be little chance of his making safe port, and a man would have little regard for life or pocketbook who would knowingly ship with such a sailor. His heirs would have difficulty in collecting life insurance from a non-suicide-paying company, and a company that would reinsure a vessel piloted by such a captain would deserve to be ranked far below even the "six-bit" class.

It is a sign of the times that even the smallest of sea-going vessels now finds it necessary to carry a compass, and it is indeed only the smallest and most insignificant boat that has not at least a sextant in its equipment. The greatest precautions, coupled with the most careful observations, are deemed necessary whenever life is in the keeping of one of our mariners. We realize more keenly the estimation by men of the value of a human life since the late example in our neighboring county of nearly three score men fighting for over two weeks to save an entombed workman, and it is the realization of the priceless trust that is his that makes the sailor so careful as to his position, direction and speed when on the high seas.

If a mature life is considered so invaluable, what price can be put upon that of a child with its wonderful possibilities just opening before it? It is trite to speak of this to a company of thinking teachers, and its triteness makes it the less appreciated. Is it not true that we teach with too little regard as to just where we are in our work, as to the direction we are heading and as to the speed with which we are sailing? The keynote of our meeting is "Progression" and seldom do we hear the call to take soundings. Am I not just when I say that ninety per cent of our discussions are as to how we can strengthen our work in this or that line and that but a small part of the remaining ten per cent is devoted to thoughtful discussions as to the effect upon our pupils of this wonderful strengthening? It all reminds me of the man who taught his calf to go without food. The only difficulty was that the contrary brute up and died just as he was ready to demonstrate the success of his experiment. We have accomplished wonderful results in the teaching of chemistry, so at least I judge by the papers that I have heard read, but are our pupils thriving under our process of feeding? Whitherward are we tending? Let us stop for a few minutes to take observations, and then if necessary retrace our steps a little, even if it does hurt our pride to hinder this wonderful progression of ours.

What are our aims as chemistry teachers? To answer this question, I can not do better than quote freely from three admirable papers written by members of our Association. Milo S. Baker, of the Lowell High, San Francisco, in his outline states them as follows:

First term.

(a) To explain chemical facts the pupil has already acquired.

(b) To acquire a knowledge of the fundamental facts in chemistry through a study of the most familiar substances.

(c) To strive to inculcate the habits.

1. Of neatness and cleanliness.
2. Of recording observations carefully and fully.
3. Of distinguishing between fact and fancy
4. Of forming judgments justified by the known facts.
5. Of suspending final judgment until all the facts are known.
6. Of verifying conjectures by further experiments.

Second term.

(a) Explanation in terms of molecular, atomic, and ionic theories of facts gained during first and second terms.

(b) Study of as many metals, non-metals, and compounds, not studied in the first term, as time will permit.

(c) Continued endeavor to fix correct habits.

Roy M. Fryer of the Sacramento High School under the head of "advantages gained in the study of chemistry" sets forth the aims as follows:

(1) It trains observation in general and teaches one to draw correct individual ideas from observations made.

(2) It gives us much useful information about natural components of the universe and the principles of manufacture and properties of artificial products.

Summed up and considerably abbreviated, the aims of chemistry teaching are:

(1) To teach certain chemical facts.
(2) To make practical application of these facts.
(3) To fix correct habits.

It would be foolish for me to quarrel with these gentlemen on the question of these aims. They are not only fair statements of the standards adopted by the teachers of chemistry as those towards which we should work, but they are also very high standards. My question is not as to whether or not we are advancing—of that there can be no question—it is rather "What depth have we beneath us?' and "Whitherward?"

The questions were forced home to me in rather an emphatic manner by the evidences of a growing distaste for chemistry by the pupils of my own classes. It was not a case of one pupil or of one class, neither was it a case of a disinclination for work on the part of lazy pupils—the complaint came from those who had shown a capacity for both work and for taking pains in other lines. In two subjects in chemistry was the

weakness most evident—in the study of theory and in carrying out of quantitative work—but in the ordinary routine of experimenting I found that my pupils were falling far short of the inculcation of "habits distinguishing between fact and fancy and of forming judgments justified by the known facts." Convinced that I had made mistakes in the outlining of the course of experiments as well as in the presentation of the subject, I began to look around me for suggestions as to how I could bring my work down to the levels of my pupils. My dismay can be well imagined when I found that, in theory at least, my fellow teachers were planning, and apparently carrying out, courses in the subject far above any that I had ever attempted. For every one quantitative experiment that we undertook they had two, three or four, while our theoretical work was to theirs as division is to square root. Little comfort was gained by writing to chemistry teachers. This definite question was sent to about half a dozen wide-awake teachers: "Do the pupils enjoy the study of chemistry as former pupils did? Why?" These are some of the answers: "All the pupils with whom I have had any acquaintance do." "I do not know." "Yes, more, because they know they are being directed, not drifting, whereas the phenomena are common to the two cases giving interest content"

I need not quote further. But one conclusion was possible. The failure was not in the amount of matter presented, for I had always advocated moderation in the presentation of all these subjects with which the pupils find difficulty, consequently the bitter fact was forced home that it was simply in my presentation of it. The conclusion still remains with me, but modified largely by further light upon the matter.

One of my former pupils returned from the University of California for his holidays, and in answer to questioning as to his work, he spoke of the difficulty the major part of the Freshman class found in chemistry. A reader in the subject had told him that at least thirty or thirty-five per cent of the pupils who had already taken the final examination had failed. In addition to this the instructor had announced his course at the beginning of the term in words similar to these: "Count four persons around you. Unless this is an exceptional class, one out of every four counted is going to fail." My pupils were without doubt represented among these failures, but "there were evidently others." Consider the proportion—twenty-five per cent at least—of the graduates in chemistry from our high schools who are unable to master Freshman work in the subject, and ask yourself if something is not wrong. The young man with whom I had been talking was very mature in thought and judgment, so I began to make inquiries further. "Did you find much difficulty in theory?" I

asked first. "No, the difficulty was not with the ionic theory," he laughingly replied, "neither was it in the mathematics of the subject"—(I had emphasized both subjects with this class)—"it is simply that we do not remember *all* of the facts told us." Another conclusion was by this forced home: Lack of thoroughness is evidently the cause of the failure of most of our graduates in their university work. Our pupils may have been taught "to distinguish between fact and fancy" to the queen's taste and their "suspension of judgment" may have been so thoroughly trained that it did not come down for use in their Freshman year in college—however that may have been, it is evident that there is lack of both thoroughness and thought in the output from our science courses.

Among the questions sent out to the high school teachers was this one: Are our chemistry graduates stronger to-day in the subject than they were five years ago? How would you have answered the question if I had addressed it to you? Your answer would have probably been that of practically every one from whom an answer was received, i. e., "Yes the present day graduates are stronger." Another question asked was: Are our graduates to-day better prepared in chemistry for the university than former graduates? This, as the former question, elicited the practically uniform reply: "Yes, they are better prepared" One very conservative teacher wrote after this question: "I would consider them better, as I think more thorough work is now done and laboratory methods have greatly improved. I would rather hear the opinion of a university instructor upon this point" The answers were as I expected they would be. I would not have sent them out if I had not received already a communication from one of the university instructors upon this same point. Knowing his extreme conservatism as well as his kindly spirit towards high school work, I feel justified in quoting very largely from his letter. It contains rich food for thought. He says: "I very seriously doubt whether any material advance has occurred for a good many years in the methods of chemistry teaching. Judging from the results of six years of Freshman work at the university I cannot see that students entering now bring with them any better knowledge or understanding of chemistry than did their predecessors—and carrying my mind still farther back to the prehistoric days when I entered the university from the 'Boys' High School of San Francisco, I can not believe that the boy of to-day is a whit wiser in a chemical way than was the boy of a quarter of a century ago. In fact, were I to make any distinction (and this may be a matter of personal prejudice) I should declare in favor of the ancient boy. Of course the new boy has heard of new theories—theories that had no existence in the olden days, but the older

theories were good enough in their day and the old boys understood facts as then explained fully as well, if not better, than the new boys.

"I do not know that there are any reasons for this condition. Possibly the new boy has too many other interests and can devote less time to chemistry; possibly the tendency exists to glorify physics too much as an 'exact' science and give to the student the idea that chemistry is an 'inexact' one and that any old thing will do; possibly it is due to the irrational and extravagant development of the laboratory method in which a raw, green student is expected to discover and digest in a term, facts and laws that have taken the leading chemists of the world a century to discover and understand."

This very kindly arraignment of the "new boy" and incidentally of the "new boy's teacher," is directly at variance with the opinions of all the high school teachers heard from. Is it not time to stop and consider "Whitherward?"

In what ways are our methods different from those in vogue fifteen years ago? At that time the labaratory method was just coming into general use, many of the experiments being spectacular (and consequently highly interesting) rather than one little part of a complex whole supposed in its entirety to exemplify some theory. Theories were read as theories and little attempt was made to more than elucidate them. The study was deductive rather than inductive. That this is not considered "the thing" now is shown by the tone of the papers presented in every meeting of the Association. I quote from a paper presented in Los Angeles by one of our members on the "Formal Discipline of Instruction in Science," it being, I think, as fair a presentation of the attitude of mind of our teachers in regard to chemistry teaching as I can find. "The chief object of education in science is no longer the acquisition of facts, but training in the *scientific* or *inductive* method, the method by which mankind has come into possession of the facts, and has discovered their significance," and further, "The problems of life require to be solved inductively." It is true that this author says later in his paper, "At every step in this subject (physics) deduction supplements induction. That alters the question not a whit. It seems quite evident that the great difference between the work to-day and that of ten or fifteen years ago lies in the fact that especial emphasis is now placed on the inductive study of the subject as opposed to the deductive tendencies of the newer but rapidly developing laboratory science. If this statement be true, and I cannot feel that there can be any question about it, then the acknowledgement that our pupils are no stronger than those of the earlier period can but be an admission that our inductive methods have not the power of

developing strength that we fondly imagined they had.

That the aims of our modern teachers of chemistry are not heartily in accord with other educators of authority besides the one I have quoted is shown by the following extract from a paper by Dr. John F. Woodhull of Teachers' College, Columbia University. He says: "Men who have spent several years passing through this sort of experience (comprehending by continued repetition) in the study of chemistry and who have arrived at pretty clear ideas themselves, undertake to teach these ideas full-fledged to beginners. Thoroughness and accuracy are their aim. To go slow and cut a wide swath is their method. They are champions of the *intensive* as against the *extensive* method. They demand of the beginners definiteness, sureness and completeness of knowledge and they attempt to make a few quantitative experiments furnish what time and extended experience alone can supply. * * * I do not object to intensive work nor to quantitative experiments. We must admit that they are the cream of the whole matter, and yet insist that, like the nutritive part of food, they must be mixed with a large bolus if digestion is to proceed. Certainly the notion that an experiment is a vehicle for training in accuracy primarily, is a very harmful superstition. * * * As for the main results to be sought I should say that, if a pupil understands his text-book in chemistry as well as the average pupil understands his history, we ought to be satisfied." Does that sound like "the aims in teaching chemistry are the cultivation of exact observation, correct interpretation of observed facts and the discovery of their relations, and rational explanation of facts and their causes by referring them to their real causes?" Is the close induction outlined in the above, our "creed" in chemistry, possible for young boys and girls of the age of our ordinary pupils? I think not, and in our striving to force them up to it, we have taken much real university work in the high school, thus crowding all but the strongest pupils out of the work, and at the same time forcing it in the category of, I believe in the ordinary case, heartily detested subjects. My experience in three high schools of the state is that very few pupils elect the course in chemistry, the common complaint being that it is too hard and too mathematical.

The texts are not wholly blameless in the matter. Answering the popular demand authors have elaborated dictionaries of facts in chemistry and sent them forth as texts. Compare one of our modern texts with one of Tyndall's works. Which would you take up during the spare half hour? How many of the innumerable facts given in the later book would you remember? To quote again from the letter which I received from the University of California instructor (Edward Booth):

"Too often the high school text-book is little more than a college text-book condensed to such an extent that all the interesting facts are omitted and it has become but slightly more interesting than a dictionary. I can conceive of a text-book that might omit about 3,147 facts and yet give a student a livelier interest in, and a better conception of chemistry than the condensed chemical encyclopedias now used as text-books." It is considered good form for high school teachers to rail at the text-books and to that extent this incomplete paper has complied with the polite usages in paper writing. The fault, however, with the text has for it root faults in the teaching of the subject, for the demand has been but answered in the supply. It is not considered good pedagogy to teach history from compendiums of facts about history—why should it be considered good teaching to use something similar to a compendium in teaching chemistry? Let us in justice to our pupils, the subject, the university, and ourselves, give into the hands of the pupils something which will be read for what is in it, of live interest, rather than study to find what is in it to explain some phenomenon or to fit in with some point in an experiment.

The following are the conclusions at which I have arrived after studying the matter:

1. We are expecting too much from our pupils in chemistry.
2. We are not making the study of chemistry interesting enough, largely because we are not making it alive enough.
3. Our laboratory work is too mechanical, because it is too often meaningless to the pupil. Less laboratory work with more discussion of what is done would bring about better results.
4. Our laboratory work is too largely quantitative. Very little quantative work should be given in the high school.
5. Our texts should copy more the style of the masters of science who have written scientific treatises. They should attempt to cover less ground, but what is given should be treated in more of a connected manner. Practical every day matters should receive much more attention, relatively, and the industrial side be much more strongly emphasized.

Having prepared the material for this paper in a spirit of criticism of my own work, I hope that the teachers will take what I have said with this idea in mind. Difficulties which I have spoken of as being general are perhaps only local, and it would not be at all surprising if the lack of interest which I have felt growing regarding chemistry has its rise in my own laboratory. You must judge of the question for yourselves. I questioned as to my own work "Whitherward?" and in answer to the request from your president, I have given you the benefit of it.

State Farmers' Institute

In Conjunction with

Section of Nature Study and Elementary Agriculture

of the

California Teachers' Association.

Prof. E. J. WICKSON, Conductor.

The Development of Educational Effort on the Kearney Estate.

Prof. E. J. Wickson, Berkeley.

WE meet to-day near a site upon which one of the most unique and interesting agricultural institutions of the world will ere long arise. The gift which will provide it a home and an income is Californian in its greatness and in its freedom from restriction; the informal suggestions of the donor do, however, clearly indicate a conception of an institution which shall be shaped by the urgent needs and the characteristic opportunities of its environment and dedicate it to the agricultural service of this grand natural division of the state—the San Joaquin Valley. On this occasion it may be proper for me to speak, briefly, about what I conceive to be possible in the development of an institution for agricultural education, research and experiment which shall best serve the prosperity of this vast and rich district of the state and the manhood and womanhood of the millions of people whom coming centuries will bring to it.

It is becoming more clearly demonstrated each day that the outfit of California for agricultural research and instruction will consist, first, of a central plant at Berkeley, where agriculture shall maintain itself creditably among other applied sciences, taking its inspiration and material of new truth from all the sources thereof, which are to be found in the highest lines of thought and inquiry which the University pursues. It will consist, second, of several closely related and correlated

outposts, where all this new truth shall be embodied in actual agricultural operations, which shall make it available to the people by practical instruction and demonstration. Nothing less than this will satisfy the people of California. The legislature declared it when it made an appropriation for a University Farm and so closely described the characters it should embody. Mr. Kearney declared it when he gave this grand property for an institution to be devoted to agricultural experiment and instruction. The attitude of the people toward this subject should be carefully and conscientiously considered and wisely acted upon.

One phase alone of a complex problem will I speak of now, but it is fundamental in the determination of the whole matter. The instruction should be distinctly and distinguishingly along lines of practical agriculture. It is not wise to duplicate the common and high schools of the state by the creation of special schools which be made of common school cloth with a fringe of technical studies. These may be good, and when such are wanted the school boards can provide them in accordance with their powers under the general school law. The conception of a school which actuated recent legislative appropriation and prompted Mr. Kearney's magnificent bequest, is entirely different. It was a conception of a special school of agriculture which shall enable people, either old or young, to concentrate their attention upon particular branches of agricultural instruction, presented in its most concrete and demonstrative form, for longer or shorter periods as their inclinations and conditions dictated. Such a school is a place to learn to do certain things in the best possible manner, the result of which would be to stimulate, direct, and make more profitable individual industry and, indirectly, to advance the quality of citizenship and general prosperity. Such an institution has no close connection with the general public school effort; it is not an agricultural grammar school, nor an agricultural high school, nor can it be secured by grafting upon such schools. Their stocks are not strong enough for such a scion: they cannot grow it to the height it should attain. The University is the only stock which can nourish it and develop it, because the University is the possessor of the science which the most advanced and successful practice is based upon. The biological sciences are the corner stone of the most successful and profitable agriculture; the application to the plant and to the animal of the truth disclosed by those sciences is the only method of reaching greater success.

The application of science which modifies and improves practice is not elementary science. This naturally is the form of science which can be grafted into the curricula of the higher grammar grades or of the high school, and enter into

the training of the scientific agriculturist. But the practical man, either young or old, with his livelihood and capital at stake, cannot wait for systematic instruction in science which must proceed from the elements upward. He must have the application of the latest and most advanced science even if he does not understand all the steps which lead to it. There is no repository of this advanced science except the University, and it is the scope of the College of Agriculture not only to possess it but to make practical application of it. The man who wishes merely to know how to do better things in the shortest time, gets the demonstration in a form which he can appreciate and imitate. At the same time the systematically trained student following regular University courses gets the demonstration and understands how it is to be theoretically accounted for. Therefore, both for the assistance of the student of agricultural practice and for the completion of the course of the student of agricultural science, the same materials and objects are used and the same improved operations are gone through, and in both cases it is the most advanced forms of agricultural science which must be shown in their application. For these reasons the conduct of such schools of the highest practice must be entrusted to the University, and for the rounding out and completion of University work in agriculture such schools of practice, situated so that they can be made representative of the best work under conditions characteristic of our chief agricultural regions, should be an integral part of the agricultural department of the University, as is contemplated in the law providing for the University Farm, and in the memoranda of Mr. Kearney, which accompanies his will giving his property to the University.

The State will require a number of auxiliary institutions of this character. Two of them are already provided for, and they are so situated that each is representative of a large and distinctive region, and so widely separated that no interference is to be anticipated. Both should be built up and equipped as well and expeditiously as possible in accordance with what, on careful examination, seem to be the particular needs and opportunities of their respective districts, and their instruction made most clearly practical and available to all who desire it.

The Nature Study Excursion.

Riley O Johnson, State Normal School, Chico.

THE work in nature study, if properly done, brings the teacher face to face with perhaps more difficult problems than any other line of school work. And if this be true of that part of the work done in the school room it is doubly so of the work done in the field. It is the purpose of this paper to define some of the problems which arise in connection with the field trip and to offer a few suggestions to aid in their solution, and further to give a few practical suggestions for making the field trip fruitful.

Before proceeding, however, to a discussion of these problems I should like to state what to my mind are the chief reasons why the excursion should have a prominent place in nature study: First, it gives to the pupil a breadth of view such as no other subject in the curriculum affords. To most children *school* means a *room* with four walls shutting the outside world out and shutting them in. It means books and paper and pen and apparatus of various kinds. Children are too seldom made to realize that school means anything else or that it has any intimate connection with anything outside of itself, hence they become contracted in mind and soul. As a consequence many of them have little appreciation for the things about them in nature and often just as little appreciation for the things of the school. They need the excursion in order to learn that their little school room is only a very minute part of the great school all about them in which they may enjoy the privileges of membership. Second, those parts of the subject which possess for the child the most intense interest mean little or nothing to him unless the question of environment enter in. This is especially true in the matter of protective coloration or protective resemblance, illustrations of which never fail to challenge the admiration of children. The stripes of the tiger and the spots of the leopard are of little significance in themselves, but when it is realized that each of these animals when at home in his habitat is often concealed almost wholly from view by these markings they then contain a world of meaning. Apart from any consideration of habitat in the case of the ancestry of the dog, the peculiar habit of this animal in turning round several times before lying down has been explained only by saying that he turns once and then, since one good turn deserves another, he continues the action. But scientific observers noticing that the wolf and other relatives of the dog often execute such motions to make a place to lie down in the tall grass which characterizes their habitat explain it as an inherited instinct.

When seen in the aquarium the dark color of the tadpole means little or nothing to the child, but when he has observed time after time in Nature that the tadpole can often be seen only with the greatest difficulty the color becomes the most interesting thing about this animal.

The first problem which confronts many teachers with regard to the field trip is that of lack of knowledge of the subject. She knows that in the field the pupils will ask many questions which she will be wholly unable to answer and she naturally shrinks from such a humiliation. How shall this problem be met? The teacher must first of all realize that in order to be successful in nature-study and especially in field work with pupils she must possess a knowledge of things apart from books, or at least the aptitude for gaining knowledge from things as well as from books. One of the chief reasons why this subject has fallen in disrepute in many places is that so many teachers had only a book knowledge of the subject, and this they sought to pass over to their pupils.

We are reminded of Montaigne's words, written more than three hundred years ago: "We toil only to stuff the memory. * * * * And like birds who fly abroad to forage for grain, bring it home in their beak, without tasting it themselves, to feed their young, so our pedants (he might *now* say 'our nature-study teachers') go picking knowledge here and there out of several authors and hold it at their tongue's end, only to spit it out and distribute it among their pupils." Nature-study must be learned by the teacher and taught to the pupil while in living contact with the things of nature. Anything less than this is not *nature*-study. The teacher who finds herself lacking in this knowledge must remedy the deficiency or give up the idea of trying to teach the subject. If she have a love or appreciation for Nature (but is without knowledge) I believe this difficulty will take care of itself as she seeks to unravel the mysteries of Nature with her pupils. She will not then be under the necessity of saying, "I don't know" to questions asked, but may say instead, "We will seek to find out." She will thus be enabled more fully to sympathize with her pupils in their struggles to see and understand, and will necessarily avoid the danger of shooting over the heads of her pupils.

If the teacher be lacking in an appreciation and love for Nature she must seek to acquire these in some way. But how can this be done? It is not always possible to place ourselves in contact with lovers of Nature who would be able to impart to us such an appreciation, nevertheless there still remains a way. The old saying, "Books are the best of things well used; abused among the worst," is as applicable in nature-study as anywhere else. Among the vast number of books on

Nature and nature-study there are a few which though true to life are capable of arousing in us the love for Nature which we may lack. Such are the books of William Hamilton Gibson, books redolent with the odor of fields and woods, and written and illustrated with a charm that will captivate all who do not set themselves stubbornly to resist. I am wholly, completely, at a loss to understand how any one with even the least imaginative power can read these books, or some of those by John Burroughs, or the volume on "Insect Life" by Fabre (styled by Darwin as "that inimitable observer"), or "Our Social and Solitary Wasps" by the Peckhams, without becoming enthusiastic over the study of Nature. Besides among the great number of interesting things mentioned in these books, those which interest us most can be seen by the most ordinary observer, and that, too, in the immediate vicinity of his own home, very often within his own door-yard. My own interest in Nature was much quickened when I found by accident the stables which the ants build for the plant-lice and the two-story nest of the summer yellow-bird, giving me at first hand the story of how she outwits the cowbird as so charmingly told by Gibson. Such sights are not reserved, as I at one time thought, for the favored few, but are placed within full view of him who has eyes to see and uses them.

Many teachers are hindered by prejudice from entering into a full appreciation of Nature. False and unfounded fear of insect larvae, mice and reptiles most be overcome, or at least greatly modified, by the teacher who would be able to instruct her pupils as she should. One of the great benefits of nature-study teaching is that, by it, superstition and needless fear are removed from the child's mind and he is thus given a saner and more intelligent view of Nature. What an enviable opportunity is mine when I can demonstrate to the child the fact that the dragon-fly is not a "stinger," that he can not "sew people's ears up," and that he is altogether a harmless, yea, more than that, a defenceless creature; when I can induce the child to prove it to his own satisfaction! What an opportunity lost if, through timidity or fear, I fail to dispel his groundless fear and superstition! I believe it to be entirely possible for any teacher who has sufficient interest in the subject so to accustom herself to all forms of animal life that she shall be able to give the nature-study lesson in school-room or field without the least show of fear. She *must* do so if she is to succeed in imparting to her pupils one of the most valuable lessons from the work.

Another problem which every teacher in conducting field work must meet is that of class discipline. One of the objections most strongly urged against the field trip is that it weakens and sometimes destroys discipline. *Whether* it does so or

not all depends upon the teacher. It is, without doubt, true that the teacher's power in that line is either greatly weakened or greatly strengthened by the class excursion. In no other line of school work is there so great need for ingenuity in maintaining discipline as in the field trip and no where else has the teacher such a great opportunity for becoming strong in government, for new problems are continually arising and some of them require unique solutions. To illustrate: On one of our excursions in the Chicago Vacation Schools, in which three hundred and fifty children from the slums participated, a number of boys, disregarding the customary regulation, went bathing in the creek. When discovered and spoken to by a teacher for the first and second time made not the least show of obedience, but when the teacher quietly stooped and gathered a few stones of a proper size for throwing (the teacher was a man in this instance), there was not a boy among the bathers who did not make all reasonable effort to get to the bank for his clothing. Now, of course, these boys felt almost certain that the teacher would not have thrown the stones, but they also knew that he could have done so if he had wanted to, and knowing that he had a way of enforcing obedience they readily yielded Without discipline the most carefully planned excursion is likely to come to nought, while a well-disciplined class in the field can hardly fail to learn enough worth the trip, even from a lesson without a plan, provided the teacher have an interest in the subject. The progressive teacher will welcome the nature-study excursion as another opportunity for strengthening her powers of discipline. It is the teacher who is always shrinking from new problems in discipline who always finds discipline most difficult. It is by no means an easy task to lay down rules for making discipline easy, for in this so much depends upon the personality of the teacher. The study of the individual child has, I believe, done more than anything else to strengthen the teacher's power to control her pupils; not the study of children as they are in school but the study of them when they are their real selves. Nowhere else, unless it be in their games, are children so much themselves as on the field trip, for with competent leadership they become so engrossed in the subject that they forget to be *otherwise* than natural If the teacher has a lively interest in the subject and each time has the excursion well planned, she will find her power of discipline becoming stronger with each succeeding trip.

The necessity for interference in discipline diminishes, of course, with numbers. It is often possible, and many times desirable to divide the class up into small groups, sometimes into pairs. This plan is especially recommended for bird work in the case of pupils in the fourth grade and above. Consid-

erable variety may be utilized in dividing up the groups. Pupils may, for instance, sometimes be allowed to choose their own partners, but it is usually better for the teacher to select the partners, choosing in such a way that the stronger students accompany the weaker, the reason for which is plainly evident. The teacher also takes a small group with her, and each time a different group, until a round of the class has been made. In group work pupils are thrown largely on their own resources, and they profit by the work just to the extent that they assume responsibility in the matter. They are made to feel the necessity of looking more sharply for distinguishing marks and are compelled to rely wholly upon their own powers of description. It is well to precede group work by some drill in the description of mounted or stuffed specimens, at least until the pupil can name and recognize the limits of the different regions of the body, and has a tolerably definite idea of the common shades of color as found in the plumage of birds. He should be encouraged where possible to make hasty sketches to show any peculiar distribution of color or markings, and to write short, concise descriptions of species unknown to him. If any particular bird is sought a signal, previously agreed upon, is given by the group first finding it, thus enabling the other groups to gather quietly and to study it. Particular subjects may sometimes be assigned to different groups, as for instance, "Watching a bird for ten or fifteen minutes and reporting upon his actions;" "A census of all the birds seen on the trip, or in a certain definite locality;" "Feeding habits of certain species," etc.

The day after the excursion should be used for a free and full discussion and comparison of notes and observation. Considerable rivalry is thus stimulated among the various groups, and questions will arise which will call for more careful observation at a future time. Sometimes the class may be divided, the intention being to see which side can make the clearer reports. In the same way a pupil on one side may describe a known bird as accurately as he can while the other side guess the name of the bird described. Group work in bird study is especially commended because the birds can thus be approached more nearly and the pupils take great delight in approaching the bird by stealth, thinking at the time, no doubt, of the ways of the Indians in approaching the animals they hunted for game. Pupils have been known to become so enthusiastic over the work when conducted according to these plans that it was almost impossible for the teacher to talk to them at intermissions about anything else. Some of these same plans slightly modified might easily be used in field work in general.

In closing I should like to express my faith in the ability of true nature-study work in the schools to endure the test of

time. I should like also to say to the friends of the subject that when our teachers have been more fully educated up to an appreciation of Nature and have had opportunity to see its wonderful possibilities when well taught, *then* the movement will take on new life. The excursion will then come to be a part of the regular program, and as such will be ever looked forward to with the greatest delight by teacher and pupil alike.

Committee Report

On Use of State Text Books in Arithmetic.

THE Committee on the Use of the State Text Books in Arithmetic desires to make the following recommendations:

1. That the course in arithmetic in the elementary school should provide, at least, for a thorough mastery of the essentials of arithmetic, to wit: (a) The fundamental operations with integers, simple, common, and decimal fractions, including per cents; (b) the ability to apply the foregoing in the solution of simple practical problems such as are met by the general public; (c) familiarity with the units of measure in common use, and the ability to use these measures in the solution of simple practical problems, including finding areas of parallelograms, triangles, trapezoids, and the volume of quadrangular and triangle prisms, of cylinders and of spheres.

2 That the time allotted to number work in the first and second school years be not more than fifteen minutes per day. That the entire omission of number work in the first school year may be made without much or any loss to the pupil.

3. That where number work is undertaken in the first school year, counting, reading, and writing of numbers be limited to 110. That this phase of the work be limited in the second school year to numbers below 1000.

That during the first and second school year all work, aside from counting, reading, and writing numbers be in the concrete, that is, with actual objects, and this work be conducted in such manner as to require pupils to acquire their knowledge through *action*, rather than through memorizing facts that are not perceived by them. That the suggestions made in Chapter I of the state text be taken as illustrative of the character of the work to be done.

4. That no attempt be made in the first and second school years to teach abstract number combinations or the processes of addition and subtraction.

5. That the work outlined in Chapter III of the text be made the work of the third school year That the material suggested in this chapter be very liberally supplemented by the teacher by additional material similar in character.

6. That the work outlined in Chapter IV be made the work of the fourth school year. That the teacher supplement the material contained in the text by additional material similar in character. That a constant review of addition and subtraction be kept up throughout this year.

7. That the material suggested in Chapters V and VI of the text be made the work of the fifth school year. That this material be very liberally supplemented by additional material similar in character. That a constant review of addition, subtraction, multiplication, and division be kept up throughout this year.

8. That the advanced state text be begun at the beginning of the sixth school year.

9. Metric System.—That schools be furnished with a meter stick, a foot ruler with the centimeters and millimeters on one side, the liter measure, and the liter block, and that pupils become familiar with these units through using them in the schoolroom. That all work with the Metric System, other than performing some simple measurements, be entirely omitted, including tables, reductions, etc. That no work whatever in the Metric System be attempted without the use of the actual measures.

10. Denominate Numbers.—That all work in Dry Measure be omitted. That the reduction of denominate numbers be limited to few simple illustrations from a single table, involving not more than two different units, as reducing quarts and pints to pints, or feet and inches to inches. That with the exception of the subtraction necessary in finding differences between dates, the addition, subtraction, multiplication, and division of compound denominate numbers be omitted.

11. That the work on Literal Quantities in Chapter IX be omitted.

12. That the work on Stocks and Bonds be limited to a discussion of the subject, to give the pupil a knowledge of what a corporation is, and what is meant by such terms as capital stock, shares, dividends, stockholders, stock broker, stock exchange, par, premium, etc. That use be made of newspaper quotations to illustrate this discussion.

13. That no definitions, as such, be taught in arithmetic.

14. That all work on geometrical figures be omitted, except as pertains to finding areas of parallelograms, triangles, trapezoids, and circles, and finding the volume of quadrangular and triangular prisms, of cylinders, and of spheres. That the areas of rectangles and the volume of rectangular solids be treated in the sixth school year, and that the remainder of the work specified on areas and volumes be taken up in the eighth school year.

15. That the subject of Longitude and Time be taken up in connection with geography in the eighth school year.

16. That only one method of computing interest be taught.

17. That all work with Roman numerals suggested in the advanced text be omitted.

18. That the work on Properties of Numbers suggested in Chapter II, be limited to factoring by inspection, and to finding by inspection the least common multiple and greatest common divisor of such numbers as occur in simple fractions; to divisibility of numbers by 2, 3, 4, 5, 9, and 10; and to the significance of the terms prime and composite as applied to number.

19. That Chapters I-VI of the advanced text be made the work of the sixth school year, excepting such parts as are recommended for omission. That a systematic review of the fundamental operations with integers be continued throughout the year.

20. That Percentage, with its application to Interest, Trade Discount, Taxes, Insurance, Commission, Discount, be made the work of the seventh school year. This is embodied in Chapter VII of the text. That a systematic review of all previous work be continued throughout the year. That supplemental materials in the topics enumerated be gathered from the activities in the community in which the school is located.

21. That the subject of proportion be omitted.

22. That Chapters VIII-XII of the text be made the work of the eighth school year, excepting such parts as are elsewhere designated to be omitted. That a systematic review of the work of the previous grades be continued throughout this year.

23. That in 9-year elementary schools the course in mathematics be made to consist of work in algebra and in constructive geometry.

24. Reviews.—That a continuous and systematic review be given throughout the entire course, both on the facts and processes involved in mechanical work and on the topics studied.

25 Oral Work.—That a considerable portion of the time in each grade be devoted to oral work, both in the mechanical work and in the solution of problems. That this oral work, when not in the nature of a review, be related to the written work of the class, and that it be not made too complicated in character.

26 Supplemental Materials.—That much supplemental work in the nature of exercises and problems, both oral and written, be provided. That this material be in line with that contained in the text. That supplemental materials in the nature of additional problems be gathered from the activities of the community, both by the teacher and the pupils.

27. Method of the Work.—That in teaching the fundamental operations with integers, the methods of the primary text be followed. That all work be made as practical as possible by dealing with situations with which the child is familiar. That whenever possible, the child should be made to *do* things, to perform the actual measurements, to make the actual drawings, to treat with others in the schoolroom in the business relations involved, etc.

28. Problems —That oral problems precede and accompany work in written problems. That no problem be presented to the pupil for solution unless the pupil is familiar with the situations and the nature of the transactions involved.

That in teaching problems the teacher observe the following steps:

a. That the pupil be required to read the problem carefully.

b. That the pupil state what facts are given and what facts he is required to find.

c. That the pupil specify the operations to be used in its solution.

d. That where possible, the pupil approximate the result.

e. That the solution be correctly and neatly expressed.

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